ACCESSION #: 9910180149

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: PILGRIM NUCLEAR POWER STATION PAGE: 1 OF 10

DOCKET NUMBER: 05000293

TITLE: Manual Scram at 27 Percent Power Due to Degrading Main

Condenser Vacuum

EVENT DATE: 09/13/1999 LER #: 1999-009-00 REPORT DATE: 10/13/99

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 27

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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Affairs Senior Engineer

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE EPIX:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On September 13, 1999, at 1825 hours, an unplanned scram was manually initiated while at 27 percent reactor power. This action was taken because of degrading vacuum in the main condenser.

The root cause of the event was the failure of the augmented offgas (AOG) system train

'B' condenser level control system in conjunction with AOG air purge flow, that overcame the capacity of the main condenser air ejector system. The AOG system bypass procedure requires the air purge. Corrective actions taken included the cleaning of a plugged level control sensing line, replacement of a level control instrument root valve and level transmitter, and loop calibrations of the AOG train 'B' condenser level control system. Other corrective actions are planned.

The event occurred during power operation while at about 27 percent reactor power. The reactor vessel pressure was about 952 psig with the reactor vessel water temperature at the saturation temperature for that pressure. The event posed no threat to public health and safety.

BACKGROUND

The main condenser gas removal system (MCGRS) functions to remove air, non-condensible gases and water vapor from the main condenser. The MCGRS consists of the steam jet air ejector (SJAE) and mechanical vacuum pump (MVP) subsystems. The MVP subsystem is operated during plant startup and shutdowns, and the SJAE is put into operation when the main condenser vacuum is about 22 inches of mercury. The SJAE subsystem consists of four primary air ejectors and two secondary air ejectors. The SJAE subsystem is normally operated with two primary air ejectors and one secondary air ejector in service. The primary air ejectors remove the air/gas/vapor mixture from the main condenser. The mixture is discharged to the inter-condenser, and the resultant condensate is directed to the main condenser hotwell. The remaining non-condensible gases are removed by the secondary air ejector. The non-condensible gases and entrained water vapor are discharged from the after-condenser for subsequent processing in the Offgas (and Augmented Offgas) System.

The Offgas System is equipped with piping, instrumentation, valves, a hold-up line, and filters. The instrumentation includes temperature sensors and indication, flow sensor and indication, and radiation monitors. The valves are manually operated, solenoid operated, and air operated. The hold-up line provides a 30 minute delay for the reduction (decay) of radioactivity of noncondensible gases (principally Krypton, Xenon, and air) prior to the offgas filters. The two offgas filters are connected in parallel and filter the offgas prior to its release to the environment via the main stack. The Offgas System sample system includes radiation monitors. The radiation monitors (RM-1705-3A/B) are calibrated to initiate alarms in the main control room and automatically initiate a signal to isolate the main stack if predetermined setpoints are achieved. The isolation signals function to automatically close isolation valves in the offgas piping to the main stack after a designed time delay when the Offgas System radiation monitors (RM1705-3A/B) are selected for service. Radiation monitors RM-1705-3A/B are selected for service via the offgas radiation monitors' selector switch (MON2 position).

The Augmented Offgas (AOG) System augments the Offgas System, and is put into service prior to achieving 50 percent reactor power. The offgas upstream of the Offgas System hold-up line is directed to the AOG System. The AOG System includes steam jet compressors, pre-heaters, catalytic recombiners, aftercondensers and related water separators, hydrogen analyzers, cooler condensers, moisture separators, pre-filters, charcoal

absorbers, and radiation monitors. Similar to the Offgas radiation monitors (RM-1705-3A/B), the AOG radiation monitors (RM-1705-5A/B) are also calibrated to initiate alarms in the main control room and automatically initiate a signal to the main stack if pre-determined setpoints are achieved. The isolation signal functions to automatically close the valves in the piping to the main stack after a designed time delay when the AOG System radiation monitors (RM-1705-5A/B) are selected for service. Radiation monitors RM-1705-5A/B are selected

for service via the offgas radiation monitors' selector switch (MON1 position). After the offgases are processed in the AOG System, non-condensible gases (offgas) from the AOG System are directed to the Offgas System hold-up line.

The principal components of the AOG System are connected in a series-parallel arrangement that consists of two trains ('A' and 'B'). The system's two condensers are connected in parallel and are located downstream of the two in-parallel recombiners. The train 'B' condenser E-306B is equipped with a temperature sensor and related temperature indicating switch, and two level transmitters LT-N006B and LT-N006D. The level switch and level transmitters are part of the controls for level valve LV-9251 that direct condensed water from E-306B to the main condenser and thereby, control water level in E-306B. The train 'B' level transmitter LT-N006B provides a signal to level switch LS-N007B and level

indicating controller LIC-R004B. Similarly, the train 'B' level transmitter LT-N006D provides a signal to level switch LS-N007D and level indicating controller LIC-R004D. The output of the train 'B' condensers' level switches and indicating controllers are directed to level valve LV-9251 by the train 'A'/'B' selector switch. The train 'A' condenser E-306A level control system is similar to train 'B' except that the train 'A' level control system controls the position of level control valve LV-9252. The level valves (LV-9251/LV-9252) are connected in-parallel and function to direct water from AOG condenser E-306A (E-306B) to the main condenser. The position of the selector switch corresponds to the AOG condenser selected for operation.

On September 13, 1999, at 0840 hours, a pre-evolution briefing was held for a planned power reduction. Principally, the power reduction involved a reduction in the reactor core flow, inserting applicable control rods, and a thermal backwash of the main condenser. After completion of the thermal backwash, the reactor was to be returned to 100 percent power. The backwash was completed by about 1605 hours. The circulating system pump 'B' was supplying cooling water to the main condenser, reactor power was about 46 percent, and main condenser vacuum was about 28.7 inches of mercury.

The AOG System was bypassed in accordance with procedure 2.2.106, 'Augmented Offgas System," at 1715 hours while at about 46 percent reactor power. This action was taken to support planned troubleshooting of the AOG

System train 'B' condenser level control loop. The troubleshooting was initiated because of E-306B level control problems experienced during AOG system operation after the 1999 refueling outage (RFO-12). The troubleshooting was conducted in accordance with procedure 3.M.1-34, "Generic Troubleshooting Procedure." Procedure 2.2.106 includes reconfiguring the offgas flowpath from the AOG System to the Offgas System, securing the AOG System steam jet compressor, and introducing air (air purge) to the AOG System. The air purge functions to dilute and/or remove hydrogen gas from the AOG System. Shortly after the AOG System was bypassed in accordance with procedure 2.2.106, the main condenser vacuum degraded slightly. Attempts were made at the main control room AOG System control panel (CP-600) and locally to stem the degrading vacuum. The air purge of the AOG System was also terminated in an effort to

stem the degrading vacuum. Continued monitoring of the vacuum by licensed operators identified a continuing degradation of the vacuum. Therefore, procedure 2.4.36, "Decreasing Condenser Vacuum," was entered, and the AOG System was then returned to service. The main condenser vacuum continued to degrade after the system was returned to service. Therefore, the nuclear operating supervisor (licensed operator) established a main condenser vacuum low limit of 24 inches of mercury for the initiation of a manual reactor scram in accordance with procedure 2.1.6, "Reactor Scram." A pre-evolution briefing was held regarding a manual scram. Just before

the main condenser vacuum low limit occurred, another pre-evolution briefing was held. The briefing included operational bands for reactor power, reactor water level control, and reactor pressure control. Applicable control rods were being inserted to further decrease reactor power.

Plant conditions just prior to the event were as follows:

o The 345 kV transmission lines, 342 and 355, were energized. The Pilgrim Station 345 kV switchyard ringbus was energized with the switchyard air circuit breakers 102, 103, 104, and 105 in the closed position. The startup transformer was in standby service. The 4.16 kV Pilgrim Station auxiliary power distribution system was being powered from the unit auxiliary transformer. The emergency diesel generators 'A' and 'B' were in standby service. The secondary source of offsite power, the 23 kV distribution system, was energized and the shutdown transformer was in standby service. The Pilgrim Station blackout diesel generator was in standby service.

o The reactor vessel pressure was about 952 psig, and the reactor water level was about +26 inches (narrow range level).

o The recirculation system motor-generator sets/pumps 'A' and 'B' were in service in the manual control mode. The reactor core flow was about 26E+06 pounds per hour.

o The three condensate system pumps and two of the three feedwater system pumps were in operation. The feedwater system train 'A'

regulating valve was in the automatic control mode and the train 'B' regulating valve was in the manual control mode. The feedwater level control system was in the three element control mode.

o The circulating water system pump 'B' was in service, and was supplying water to three of the four main condenser waterboxes.

o The main condenser vacuum was degrading, at slightly greater than 24 inches of mercury. The main condenser steam jet air ejectors were operating in their normal alignment.

o The offgas system configuration was as follows. The AOG System was unbypassed, with the system's train 'B' jet com ressor in service.

EVENT DESCRIPTION

On September 13, 1999, at about 1825 hours, the reactor mode selector switch was manually changed from the RUN position to the SHUTDOWN position while the reactor was at 27 percent power. This intentional action resulted in the expected, designed actuation of the reactor protection system (RPS) and reactor scram. This action was taken because of degrading main condenser vacuum conditions. At the time of the scram, the main condenser vacuum was 24 inches of mercury.

The RV water level decreased to about +2 inches (narrow range level) due to the decrease in the void fraction in the RV water. The decrease to less than the low RV water level setpoints (calibrated at about +12 inches) resulted in the automatic initiation of the Primary Containment Isolation

Control System (PCIS) and Reactor Building Isolation Control System (RBIS).

The PCIS actuation resulted in the following designed responses:

o The automatic closing of the Primary Containment System (PCS) Group 2/reactor water sample valves AO-220-44 and AO-220-45.

o The automatic closing of the PCS Group 2/sampling system isolation valves that were open.

o The PCS Group 3/residual heat removal (RHR) system (shutdown cooling mode) isolation valves MO-1001-47 & MO-1001-50 remained closed.

o The PCS Group 3/RHR low pressure injection valves MO-1001-29A/B remained closed.

o The automatic closing of the PCS Group 6/reactor water cleanup (RWCU) system inboard and outboard isolation valves.

The RBIS actuation resulted in the automatic start of the Standby Gas Treatment System (SGTS) trains 'A' and 'B', and automatic closing of the Reactor Building/Secondary Containment System (SCS) Trains 'A' and 'B' supply and exhaust ventilation dampers.

Initial Control Room operator response was orderly and included the following. EOP-01, "RPV Control," was entered because the RV water level was less than +12 inches. All control rods inserted into the reactor core. Control rod 18-39 indicated a position of 02. A position indication of 02 or greater (i.e., 00) meets the definition for a fully inserted control rod. Control rod 18-39 was then inserted to the 00 position. EOP-02 was entered because the position indication for eight other control rods could

not be immediately verified (position indication of -99 on the plant information computer). Full-in position indication for these eight control rods was subsequently verified by the rod position indication system, and EOP-02 was terminated.

At 1837 hours, the reactor water level was restored to about +28 inches.

The Group 6 portion of the PCIS was reset and the RWCU System was returned to service.

Procedure 2.1.6, "Reactor Scram," was completed by 1839 hours.

At 1841 hours, the RPS was reset and EOP-01 was terminated. Procedure 2.1.5 section B, "Operation After Reactor Scram With MSIVs Open," was entered. The reactor vessel pressure stabilized at about 840 psig with the reactor water level at about +30 inches (narrow range level). The main condenser vacuum improved as a result of the scram and continued to improve thereafter.

The RBTS was reset at about 1859 hours. The SGTS was returned to normal standby service, and the reactor building ventilation system was returned to service.

Problem Report 99.9519 was written to document the scram. The NRC Operations Center was notified in accordance with 10 CFR 50.72(b)(2)(ii) at 2010 hours on September 13, 1999.

The scram occurred during power operation while the reactor vessel pressure was about 952 psig, with the reactor vessel water temperature at the

saturation temperature for that pressure.

A critique of the event was conducted in accordance with procedure 1.3.63, "Conduct of Critiques." The critique was attended by applicable personnel including Operations, Maintenance (I&C, Mechanical, and Planning), and other personnel that were on-shift at the time of the event. The critique and subsequent reviews determined the operator actions taken were appropriate with no identified human performance problems.

A post trip review was conducted in accordance with procedure 1.3.37 (rev. 17), "Post-Trip Reviews." The procedure includes a check of various operational parameters and aspects of Pilgrim Station design. Based on the review findings, the cause of the trip was known and in the process of correction, all safety-related and/or important equipment functioned properly, any malfunctioning equipment could be readily corrected, there were no Technical Specifications constraints to plant restart, and post trip parameter performance was within the Updated Final Safety Analysis and reload analysis. Therefore, the reactor could be maintained in a hot shutdown condition, pending the completion of immediate corrective actions.

A problem report (PR 99.2220) was written to document the problem with the plant information computer position indications for the control rods that did not initially indicate a full-in indication. PR 99.2213 was written to document the initial insertion of control rod 18-39 to the 02 position indication.

CAUSE

The direct cause of the scram signal that initiated the scram was the intentional movement of the reactor mode selector switch from the RUN position to the SHUTDOWN position while at about 27 percent reactor power. This action was taken because of degrading vacuum conditions in the main condenser.

The root cause of the degrading main condenser vacuum conditions was the failure of the AOG system train 'B' condenser E-306B level control system in conjunction with AOG air purge flow, that overcame the capacity of the main condenser steam jet air ejector system.

A review of plant parameters during the event and the as-found condition of equipment after the event determined that the sensing line for the train 'B' condenser E-306B level transmitter LT-N006D was blocked (rust-like, magnetic substance). The blockage caused the transmitter to erroneously sense a high water level condition of E-306B. The erroneous signal from LT-N006D caused the E-306B level control valve (LV-9251) to remain fully open, rather than to modulate the position of LV-9251 and hence, the level control loop did not maintain the proper water level in E-306B (empty instead of water in it). In addition, the AOG System was bypassed just prior to the event in accordance with procedure 2.2.106. As part of the bypass, the AOG System train 'B' steam jet compressor was removed from service, and an air purge of the AOG System was initiated in accordance with the procedure. A positive pressure air purge of about 16 SCFM (at

service air pressure) was introduced into the AOG System while the system was bypassed. The 16 SCFM was based on a service air pressure (gauge pressure) versus absolute pressure (e.g., main condenser vacuum). Because the main condenser pressure was being maintained at a vacuum (not gauge pressure) when the AOG System was bypassed, the air purge resulted in a flowrate of about 24 SCFM to the main condenser. The fully open train 'B' level control valve (LV-9251) provided an air pathway from the AOG System condenser E-306B to the main condenser. Consequently, the air purge (about 24 SCFM to the main condenser) overcame the capacity of the main condenser steam jet air ejector system and resulted in the degraded main condenser vacuum.

Factors contributing to the event included the administrative controls of the work being performed (AOG System troubleshooting before the event) that did not recognize and/or forewarn the operating crew of the potential challenge to the main condenser vacuum while the AOG System was bypassed.

CORRECTIVE ACTION

Corrective actions taken included the following (PR 99.9519):

o Inspection of the instrument sensing lines to the E-306B level transmitters,

o Cleaning of plugged sensing lines to the E-306B level transmitter LT-N006D,

o Boroscopic inspection (satisfactory results) of E-306B shell region

where the nozzle of the sensing line (to LT-N006D) is located,

o Replacement of LT-N006D,

o Replacement of E-306B instrument root valve HO-118D (to LT-N006B),

o Calibration of the individual E-306B level instruments,

o Loop calibrations of the E-306B level control system.

Corrective actions planned include the following that will be tracked as part of the corrective action program (PR 99.9519):

o Revision of the Operations Policy Manual and/or procedure 1.3.34 (currently rev. 56), "Conduct of Operations." The focus of this action is to provide criteria for allowing on-line diagnostic testing (procedure 3.M.1-34, "Generic Troubleshooting Procedure"). An interim management control measure, Plant Manager approval for planned troubleshooting or off-normal testing, was issued on September 21, 1999. Guidelines for Operations Department approval of troubleshooting and non-routine testing were issued to Operations Shift Superintendents and Shift Supervisors. The guidelines were issued on September 28, 1999. These interim measures were initiated until the planned corrective action is taken.

o Review of the implementation of a recent design change (PDC 95-08) including the related post-work testing of the AOG System train 'A' (train 'B') condenser E-306A (E-306B) level control system. [The AOG System train 'A' and 'B' level control systems (level transmitters, and level control valves LV-9251 and LV-9252) were replaced by an

engineering design change. The design change (PDC 95-08) was implemented during the 1995 refueling outage (RFO-10). The train 'B' level control system was post-work tested as part of RFO-10. The train 'A' level instruments and level control loops were post-work tested as part of the 1999 refueling outage (RFO-12).]

These planned corrective actions may be supplemented or modified as part of the corrective action process (PR 99.9519).

OTHER ACTIONS TAKEN

Reactor startup (criticality) was initiated at 0450 hours on September 18th, the unit was returned to commercial service at 2357 hours on September 19th, and 100 percent power operation was achieved at about 1030 hours on September 21st.

SAFETY CONSEQUENCES

The event posed no threat to public health and safety.

The Offgas System and Augmented Offgas System function to process offgas resulting from the nuclear fuel fission process. After processing, gases from the Offgas/Augmented Offgas System are directed to the main stack for release to the environment. The systems each contain separate radiation monitors that function to monitor the activity of the gases to be released into the atmosphere, and automatically initiate isolation signals to the main stack isolation valve if predetermined setpoints are achieved. The offgases that were being processed at the time of the

event did not exceed the setpoints that would have required the isolation of the main stack isolation valve. Moreover, there were no new gaseous release paths introduced to the environment during or as a result of the event.

The scram signal (15 percent high neutron flux) that initiated the scram was the expected designed response to the intentional movement of the reactor mode selector switch from the RUN position while at 27 percent reactor power.

The decrease in the RV water level was the expected response to the scram and accompanying shrink in the RV water. The PCIS and RBIS actuations were the expected designed responses to a low RV water level condition (i.e., less than about +11.6 inches).

The Technical Specification Table 3.2.B trip setting for automatic actuation of the core standby cooling systems (CSCS) is -46.3 inches. During the event, the lowest reactor vessel water level that occurred, about +2 inches, was about 48 inches above the CSCS setpoint. In addition, the level was about 129 inches above the level (-127 inches) that corresponds to the top of the active fuel zone.

Moreover, the level (+2 inches) was greater than the setpoint, calibrated at about -46.3 inches, that initiates the anticipated transient without scram (ATWS) system functions for a recirculation pump trip (RPT) and alternate rod insertion (ARI). The highest reactor vessel pressure that occurred, 952 psig, was less than the setpoint, calibrated at about 1175

psig, that initiates the ATWS system RPT and ARI functions and was less than the setpoint, calibrated at about 1400 psig, that initiates the ATWS function for a feedpump trip.

REPORTABILITY

This report was submitted in accordance with 10 CFR 50.73(a)(2)(iv) because the scram, although a designed response to the intentional movement of the reactor mode selector switch from the RUN position to the SHUTDOWN position while at about 27 percent reactor power, was not planned.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station LERs submitted since 1984. The review focused on similarities involving an automatic or manual scram(s) and degrading main condenser vacuum conditions. The review identified LER 89-023-00.

LER 89-023-00 involved decreasing main condenser vacuum conditions that resulted in the initiation of a manual scram, and was due to an inadequacy in procedure 2.2.93 (Main Condenser Vacuum System) that was being used to reconfigure the main condenser gas removal system steam jet air ejectors just before the event.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS CODES

condenser (main, inter-condenser, after-condenser) COND

Control, indicating, level (LTC-R004D) LTC

Ejector (SJAE) EJC

Transmitter, level (LT-N006D) LT

Valve, level (LV-9251) LV

SYSTEMS

Condenser system SC

Condenser vacuum system (MCGRS) SH

Containment isolation control system (PCTS/RBIS) JM

Engineered safety features actuation system

(RPS, PCIS, RBIS) JE

Main turbine system TA

Plant protection system (RPS) JC

Reactor building (SCS) NG

Reactor recirculation system AD

Reactor water cleanup system (RWCU) CE

Standby gas treatment system (SGTS) BH

ATTACHMENT 1 TO 9910180149 PAGE 1 OF 1 HATTACHMENT 1 TO 9910180149 PAGE 1 OF 1

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Pilgrim Nuclear Power Station

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Plymouth, MA 02360

J. F. Alexander

Director

Nuclear Assessment

October 13, 1999 10 CFR 50.73

ENGC Ltr. 2.99.108

U.S. Nuclear Regulatory Commission

ATTN: Document Control Desk

Washington. DC 20555

Docket No. 50-293

License No. DPR-35

The enclosed Licensee Event Report (LER) 99-009-00, "Manual Scram at 27 Percent Power Due to Degrading Main Condenser Vacuum," is submitted in accordance with 10 CFR 50.73.

This letter contains no commitments.

Please do not hesitate to contact me if there are any questions regarding this report.

Sincerely,

/s/

J. F. Alexander

DWE/sc

Enclosure

cc: Mr. Hubert J. Miller

Regional Administrator, Region 1

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